Testimony of

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Subcommittee on Emerging Threats, Cybersecurity and Science and Technology

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Introduction

Good afternoon Chairman Langevin, Ranking Member McCaul, and distinguished members of the Subcommittee. It is an honor to appear before you today to discuss the important legislation before the Committee. In particular, I have been asked to focus my remarks on the workforce needs required to meet the challenges of technical nuclear forensics programs.

My name is Carol Burns and I am the Group Leader for the Nuclear and Radiochemistry Group at Los Alamos National Laboratory. Employees in this group contribute to our nation's capability for nuclear and radiological forensics. I have more than 20 years of experience investigating the chemistry of radioactive elements. I also served on detail to the Office of Science and Technology Policy, providing technical and policy support on issues associated with nuclear threats. I staff and maintain our radioanalytical capability, and as such, am a "consumer" of the product of our educational pipeline.

There are three main points I would like to convey to you this afternoon. First, the national laboratories underpin the nation's nuclear forensics capability. Second, we face a challenge in sustaining our workforce, and finally, I'd like to offer some ideas on how we can go about bringing in the next generation of forensics experts.

Forensics: Role of the National Laboratories

The Department of Energy's National Nuclear Security Administration (NNSA) and the NNSA laboratories, of which Los Alamos National Laboratory is one, contribute to the nation's security through their primary mission of ensuring the safety and reliability of the nation's strategic nuclear deterrent. Building upon the NNSA's core nuclear weapons mission, the DOE and NNSA national laboratories are important technical providers to a number of national security sponsors who have relied on our unique capabilities since the days of the Atomic Energy Commission. These capabilities have grown in importance and relevance since September 11, 2001, in meeting the mission requirements of a number of agencies involved in combating weapons of mass destruction, homeland security, and homeland defense.

More specifically, Los Alamos and the other DOE national laboratories are major contributors to our nation's capability for nuclear and radiological forensics. This work is currently funded at Los Alamos and partner laboratories by the Department of Energy, the Department of Homeland Security, and other agencies.

Many disciplines are involved at Los Alamos in the different facets of technical nuclear forensics. Chemists and materials scientists evaluate signatures that will distinguish the origin of interdicted nuclear or radiological materials. Nuclear physicists and engineers develop tools to rapidly characterize the threat presented by a suspect device in the field. Radiochemists separate and characterize the composition of complex mixtures of isotopes in debris in the wake of a nuclear or radiological explosion. Scientists at LANL also develop ways to interpret the radiation and other signatures from a nuclear event, provide expertise on nuclear materials production methods and signatures, and model potential improvised nuclear devices.

These activities are strongly supported both by unique knowledge (e.g. device design) and special facilities for handling radiological and special nuclear materials spanning the spectrum from environmental samples to significant quantities of interdicted material.

It is important to see that much of this current capability resides in the national laboratories, but it is also important to understand whether the need for these skills will extend into the future. Qualitative information has been compiled which identifies the continuing demand for workers in disciplines pertinent to nuclear and radiological forensics. In 2004, the National Science and Technology Council (NSTC) Interagency Working Group on Critical Workforce Needs, led by NNSA, collected data from 38 participating organizations spanning the defense, homeland security and the intelligence communities on hundreds of critical skills and the expected difficulty that would be encountered in hiring these skills over the next 5-10 years. Among the thirty critical skills ranked highest by the national security community as those in which they expected to have difficulty hiring are physical science areas such as radiation effects, radiation damage, nuclear instrumentation, health physics, nuclear physics, nuclear forensics, and nuclear and radiochemistry (data compiled by Dr. Beverly Berger, NA-11, NNSA). While this survey is not quantitative, it indicates a continuing need for these critical skills.

Challenges: Recruitment, Retention, Depth and Facilities

The laboratories face challenges in recruiting and retaining a qualified workforce to carry out elements of this important work. The overall aging demographic of the NNSA workforce is well known. In 2006 NNSA indicated that about 40% of nuclear weapons program technical staff members were eligible for retirement. An independent estimate provided by the Department of Energy/National Science Foundation Nuclear Science Advisory Committee (NSAC) report issued in 2004 (http://www.sc.doe.gov/np/nsac/docs/NSAC_CR_education_report_final.pdf) entitled "Education in Nuclear Science" suggests that within ten years "more than three quarters of the workforce in nuclear engineering and at the national laboratories will reach retirement age." More specific information is available in the form of a survey conducted by the National Technical Nuclear Forensics Center within DNDO of national laboratory demographics specific to technical nuclear forensic programs. Of those workers the laboratories identified as working on nuclear forensic efforts for more than 50% of their effort, the majority are more than 50 years old. A true need exists to replenish this workforce.

Although the workforce does need to be replenished, my experience at Los Alamos demonstrates that some requisite knowledge cannot be acquired through formal education, but must be learned first-hand or taught by experienced workers. For instance, both at Los Alamos and nationwide, we have a dwindling number of radiochemists who have analyzed the debris from a nuclear explosion and worked with designers to assess the nature of a device. It takes years working with senior staff and retirees to build this competence in a new worker, even if he or she starts with a sound knowledge of radiochemistry.

Another concern is the depth of our capability and the physical limits of some of our infrastructure. At our current staffing levels, we will tax the capacity of our people with the surge of samples that might be expected in the case of a major event such as the detonation of a nuclear device. Of equal concern is the sustainability of the facilities in which these dedicated researchers work. Across the DOE complex, many of the facilities where we conduct radiological work are greater than 50 years old and are coming close to the end of their useful lifetime.

An additional issue is whether the academic pipeline exists to provide a source of workers. Several recent studies have been conducted that point to the overall decline in research and education infrastructure in traditional "feeder" disciplines. As an example, the previously mentioned NSAC report evaluated national trends in the production of doctoral degrees in nuclear science (principally nuclear physics and nuclear chemistry). This report found that the level of Ph.D. production had decreased by about 20% since the mid-1990s and was down by "about half of the all-time highs reached in the mid-1970s" (Figure 1).

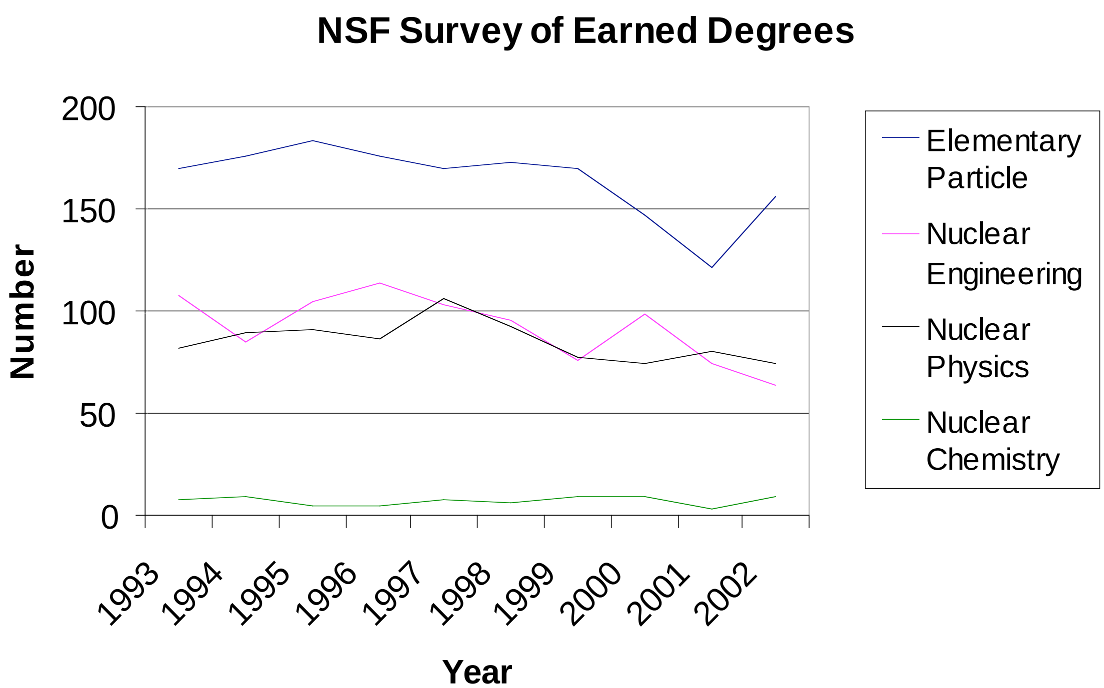

Figure 1. Number of Ph.D.s per year in selected disciplines

The report further indicated that U.S. colleges and universities were losing faculty positions in nuclear physics and nuclear chemistry.

The picture is starker in some disciplines. Figure 2 depicts the number of degrees awarded in nuclear and radiochemistry. Indeed, nuclear chemistry is no longer even tracked as a chemistry degree subcategory by the National Science Foundation. The number of faculty in nuclear and radiochemistry has also declined significantly; an evaluation of the 2005 *Directory of Graduate Research* entries indicates that 75% of faculty in nuclear or radiochemistry in that year were over 50 years of age.

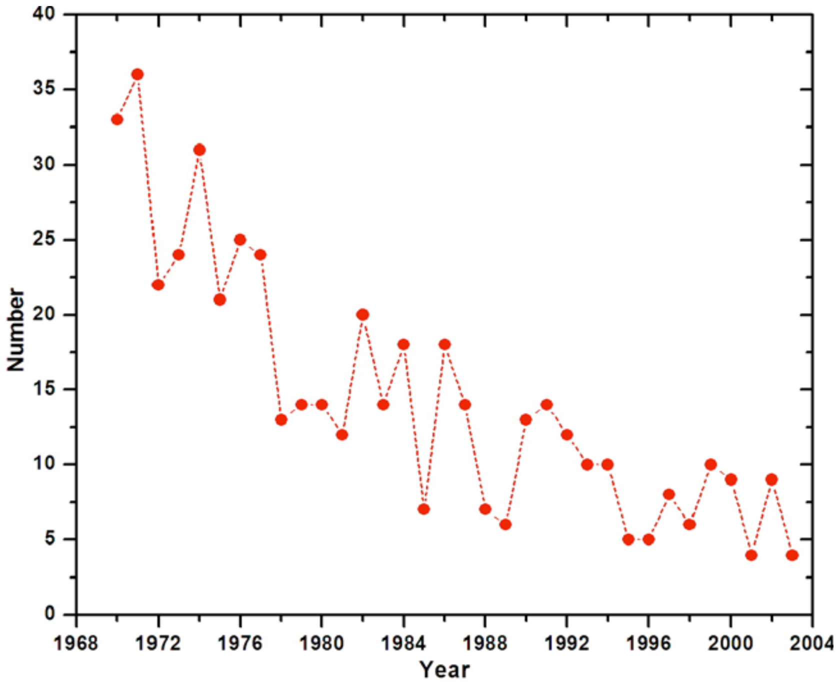

Figure 2. Radiochemistry & Nuclear Chemistry Ph. D.s Earned at U. S. Universities: 1970-2003 (data derived from ORISE 1970-72; NSF 1994-2003)

The overall status of these fields was summarized in a 2007 National Research Council Report, "Future of U.S. Chemistry Research: Benchmarks and Challenges." This report finds that U.S. preeminence in chemistry research is threatened, and in particular, "in some core subareas, such as main group chemistry and nuclear and radiochemistry, the U.S. position has already noticeably diminished based on publication and citation rates."

Competition between the workforce needs of technical nuclear forensics and those of other technology areas could exacerbate shortages. A National Academy of Sciences report on the state of science in nuclear medicine (http://www.nap.edu/catalog.php?record_id=11985) highlights a shortage of trained scientists, and the American Physical Society has recently initiated a review through the Panel on Public Affairs of the workforce and educational facilities' readiness to meet the challenges of nuclear energy.

Seeking Solutions--Some Progress

My third, and final point is that there are things that can and are being done to improve this situation. Given that few students are likely to encounter courses in nuclear science at the undergraduate level, programs such as the American Chemical Society-sponsored and DOE-funded summer schools in nuclear and radiochemistry are a welcome venue for undergraduate students to be exposed to the disciplines. These programs have seen a steadily growing number of applicants since their inception, and approximately 70% of participants go on to physics or chemistry graduate school, most who concentrate on nuclear chemistry or radiochemistry.

The DOE national laboratories are also responding to the need to integrate students into these disciplines, and have provided summer educational experiences for students and postdoctoral fellowships for a number of years. We are now seeking to formalize broader-scale partnerships with universities. Los Alamos National Laboratory has formed the National Security Education Center, which is comprised of a number of academic institutes, partnerships with universities, and consortia of universities. The institutes serve LANL and our sponsors by recruiting new staff and providing educational opportunities that will enhance retention at the Laboratory. Through the LANL consortium's Institute for Advanced Studies, we are currently developing proposals for summer programs in forensics, and research partnerships with universities in relevant technical disciplines such as radiochemistry. Successful models in other fields exist at LANL's institutes that have addressed educating and recruiting staff in information technology, engineering, and materials science.

While I think there is room for optimism in terms of some of the new programs that are being developed, there is an important caution to be noted. It takes two things to produce a Ph.D. student: both the student, and sustained funding for research in a relevant subject to generate a thesis. Research is the primary means of training graduate students. In addition to recruiting students, we must provide a sustained base of research funding in a broader range of nuclear-related fields. It is likely, however, that we will not be able to build a sufficient base of employees trained academically in these disciplines. It is important to enlist scientists from other disciplines in solving the technical challenges of nuclear forensics. In order to broaden our technical base, we will need to compensate for the fact that most U.S. universities do not have the infrastructure to routinely train scientists and engineers in the handling of radioactive materials. We must provide a broader range of scientists with access to the facilities and tools to conduct work on radiological and nuclear, perhaps through cooperative programs at the national laboratories.

Conclusion

In conclusion, I'd like to say that it is gratifying that the agencies active in the nuclear forensics field have recognized and are responding to the need to sustain and build our nuclear forensics capabilities. I look forward to the partnerships we will build between the DOE laboratory system and the academic community to implement these approaches.

If the nation succeeds in developing this workforce, the benefits will extend beyond nuclear forensics. A stronger educational pipeline in nuclear disciplines will help the nation meet the challenges of nonproliferation, nuclear energy, nuclear medicine, and environmental management.

I thank you for your attention, and will be happy to answer any questions.

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